

# The Robots Are Here: Navigating the Generative AI Revolution in Computing Education

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## Abstract

Recent advancements in artificial intelligence (AI) and specifically generative AI (GenAI) are threatening to fundamentally reshape computing and society. Largely driven by large language models (LLMs), many tools are now able to interpret and generate both natural language instructions and source code. These capabilities have sparked urgent questions in the computing education community around how educators should adapt their pedagogy to address the challenges and to leverage the opportunities presented by this new technology. In this working group report, we undertake a comprehensive exploration of generative AI in the context of computing education and make five significant contributions. First, we provide a detailed review of the literature on LLMs in computing education and synthesise findings from 71 primary articles, nearly 80% of which have been published in the first 8 months of 2023. Second, we report the findings of a survey of computing students and instructors from across 20 countries, capturing prevailing attitudes towards GenAI/LLMs and their use in computing education contexts. Third, to understand how pedagogy is already changing, we offer insights collected from in-depth interviews with 22 computing educators from five continents. Fourth, we use the ACM Code of Ethics to frame a discussion of ethical issues raised by the use of large language models in computing education, and we provide concrete advice for policy makers, educators, and students. Finally, we benchmark the performance of several current GenAI models/tools on various computing education datasets, and highlight the extent to which the capabilities of current models are rapidly improving. There is little doubt that LLMs and other forms of GenAI will have a profound impact on computing education over the coming years. However, just as the technology will continue to improve, so will our collective knowledge about how to leverage these new models and tools in educational settings. We expect many important conversations around this topic will emerge as the community explores how to provide more effective, inclusive, and personalised learning experiences. Our aim is that this report will serve as a focal point for both researchers and practitioners who are exploring, adapting, using, and evaluating GenAI and LLM-based tools in computing classrooms.